WHAT IS CLAIMED IS:

1. A magnetic sensing element comprising a multilayer film including a first antiferromagnetic layer, a pinned magnetic layer, a non-magnetic material layer and a free magnetic layer in that order from the bottom,

wherein the free magnetic layer comprises a first free magnetic layer having a predetermined dimension in the track-width direction and a second free magnetic layer which is provided on the first free magnetic layer and which has a dimension in the track-width direction larger than that of the first free magnetic layer, a second antiferromagnetic layer for aligning the magnetization direction of the free magnetic layer in one direction is provided as a layer above the second free magnetic layer, and a pair of electrode layers are provided on both side portions of the multilayer film.

2. The magnetic sensing element according to Claim 1, wherein the first free magnetic layer and the second free magnetic layer are provided as an integrated ferromagnetic layer.

3. The magnetic sensing element according to Claim 1, wherein a non-magnetic intermediate layer is provided between the first free magnetic layer and the second free magnetic layer.

4. The magnetic sensing element according to Claim 3, wherein the non-magnetic intermediate layer comprises one of Ru, Re, Pd, Os, Ir, Cr, Pt, Au, Cu and Rh or an alloy of at least two of them.

5. The magnetic sensing element according to Claim 4, wherein the non-magnetic intermediate layer comprises Cu.

6. The magnetic sensing element according to Claim 1, wherein the dimension in the track-width direction of the first free magnetic layer is 0.18 μm or less.

7. The magnetic sensing element according to Claim 6, wherein the dimension in the track-width direction of the first free magnetic layer is 0.15 μm or less.

8. The magnetic sensing element according to Claim 1, wherein [(the difference calculated by subtracting the film thickness of the free magnetic layer in the track-width region from the film thickness of the free magnetic layer in both side regions of the track-width region) / the film thickness of the free magnetic layer in the track-width region] × 100 (%) is within the range of -80% or more, but less than 0%.

9. The magnetic sensing element according to Claim 1, wherein the film thickness of the second free magnetic layer in both side regions of the track-width region is 10

angstroms or more, but 50 angstroms or less.

10. The magnetic sensing element according to Claim 1, wherein the film thickness of the free magnetic layer in the track-width region is 30 angstroms or more, but 50 angstroms or less.

11. The magnetic sensing element according to Claim 1, wherein the second antiferromagnetic layer is laminated on the track-width region of the second free magnetic layer as well, and the film thickness of the second antiferromagnetic layer on the track-width region is smaller than the thickness of the second antiferromagnetic layer in both side regions located on both sides thereof.

12. The magnetic sensing element according to Claim 11, wherein the second antiferromagnetic layer provided on the track-width region of the second free magnetic layer has a non-antiferromagnetic property, and both the side regions of the second antiferromagnetic layer have an antiferromagnetic property.

13. The magnetic sensing element according to Claim 11, wherein the second antiferromagnetic layer is provided on the track-width region of the second free magnetic layer so as to have a film thickness of 50 angstroms or less, or no antiferromagnetic layer is provided on the track-width region of the free magnetic layer.

14. The magnetic sensing element according to Claim 11, wherein the spacing in the track-width direction between the inner end surfaces of both the side regions of the second antiferromagnetic layer is smaller than or equal to the dimension in the track-width direction of the first free magnetic layer.

15. The magnetic sensing element according to Claim 11, wherein the spacing in the track-width direction between the inner end surfaces of both the side regions of the second antiferromagnetic layer is larger than the dimension in the track-width direction of the first free magnetic layer.

16. The magnetic sensing element according to Claim 11, wherein the second antiferromagnetic layer is directly laminated on the second free magnetic layer.

17. The magnetic sensing element according to Claim 16, wherein successive film formation of the second antiferromagnetic layer is performed on the second free magnetic layer.

18. The magnetic sensing element according to Claim 1, wherein a pair of the second antiferromagnetic layers having a spacing are provided on the second free magnetic layer with a third antiferromagnetic layer therebetween.

19. The magnetic sensing element according to Claim 18, wherein a non-magnetic intermediate layer is laminated between the third antiferromagnetic layer and the second antiferromagnetic layer.

20. The magnetic sensing element according to Claim 18, wherein the central portion of the third antiferromagnetic layer has a non-antiferromagnetic property, and both side regions of the third antiferromagnetic layer have an antiferromagnetic property.

21. The magnetic sensing element according to Claim 18, wherein the film thickness of the third antiferromagnetic layer is 5 angstroms or more, but 50 angstroms or less.

22. The magnetic sensing element according to Claim 18, wherein successive film formation of the third antiferromagnetic layer is performed on the second free magnetic layer.

23. The magnetic sensing element according to Claim 1, wherein a pair of the second antiferromagnetic layers having a spacing in the track-width direction are provided on the second free magnetic layer through a pair of ferromagnetic layers provided so as to have a spacing in the track-width direction.

24. The magnetic sensing element according to Claim 23,

wherein successive film formation of the second antiferromagnetic layers is performed on the ferromagnetic layers.

25. The magnetic sensing element according to Claim 23, wherein the total film thickness of the film thickness of the ferromagnetic layer and the film thickness of the second free magnetic layer is smaller than the total film thickness of the film thickness of the first free magnetic layer and the film thickness of the second free magnetic layer.

26. The magnetic sensing element according to Claim 23, wherein a non-magnetic intermediate layer is laminated between the second free magnetic layer and the ferromagnetic layer.

27. The magnetic sensing element according to Claim 26, wherein the non-magnetic intermediate layer comprises at least one noble metal of Ru, Re, Pd, Os, Ir, Pt, Au, Rh and Cu.

28. The magnetic sensing element according to Claim 26, wherein the non-magnetic intermediate layer comprises Cr.

29. The magnetic sensing element according to Claim 23, wherein the spacing in the track-width direction between the pair of second antiferromagnetic layers is smaller than or equal to the dimension in the track-width direction of the

first free magnetic layer.

30. The magnetic sensing element according to Claim 23, wherein the spacing in the track-width direction between the pair of second antiferromagnetic layers is larger than the dimension in the track-width direction of the first free magnetic layer.

31. A method for manufacturing a magnetic sensing element comprising the following steps of:

(a) forming a multilayer film in which a first antiferromagnetic layer, a pinned magnetic layer, a non-magnetic material layer and a first free magnetic layer are laminated on a substrate in that order;

(b) removing both the end portions in the track-width direction of the multilayer film;

(c) forming electrode layers on both sides in the track-width direction of the multilayer film;

(d) laminating a second free magnetic layer having a dimension in the track-width direction larger than that of the first free magnetic layer on the first free magnetic layer; and

(e) forming a second antiferromagnetic layer as a layer above the second free magnetic layer.

32. The method for manufacturing a magnetic sensing element according to Claim 31, wherein a non-magnetic intermediate layer is laminated on the first free magnetic

layer in the step (a), and a step of removing a part of or all of the non-magnetic intermediate layer is included between the step (c) and the step (d).

33. The method for manufacturing a magnetic sensing element according to Claim 31,

wherein the second free magnetic layer is formed, and successively, the second antiferromagnetic layer is formed in the step (d), and

wherein the step of:

(f) removing the second antiferromagnetic layer on the track-width region of the free magnetic layer so as to make the film thickness of the second antiferromagnetic layer on the track-width region smaller than the film thickness of the second antiferromagnetic layer located on both sides thereof is included in place of the step (e).

34. The method for manufacturing a magnetic sensing element according to Claim 33, wherein the central portion of the second antiferromagnetic layer provided on the track-width region is made to have a non-antiferromagnetic property, and the second antiferromagnetic layer in both side regions of the central portion is made to have an antiferromagnetic property through the step (f).

35. The method for manufacturing a magnetic sensing element according to Claim 33, wherein the film thickness of the central portion of the second antiferromagnetic layer is

made to be 50 angstroms or less in the step (f).

36. The method for manufacturing a magnetic sensing element according to Claim 33, wherein the spacing in the track-width direction between the inner end surfaces of both the side regions of the second antiferromagnetic layer is made smaller than or equal to the dimension in the track-width direction of the first free magnetic layer in the step (f).

37. The method for manufacturing a magnetic sensing element according to Claim 33, wherein the spacing in the track-width direction between the inner end surfaces of both the side regions of the second antiferromagnetic layer is made larger than the dimension in the track-width direction of the first free magnetic layer in the step (f).

38. The method for manufacturing a magnetic sensing element according to Claim 31, comprising the steps of:

(g) successively forming a third antiferromagnetic layer on the second free magnetic layer between the step (d) and the step (e); and

(h) forming a pair of the second antiferromagnetic layers having a spacing in the track-width direction on the third antiferromagnetic layer in place of the step (e).

39. The method for manufacturing a magnetic sensing element according to Claim 38, wherein the third

antiferromagnetic layer is formed to have a film thickness providing a non-antiferromagnetic property in the step (g).

40. The method for manufacturing a magnetic sensing element according to Claim 38, wherein the film thickness of the third antiferromagnetic layer is made to be 5 angstroms or more, but 50 angstroms or less in the step (g).

41. The method for manufacturing a magnetic sensing element according to Claim 38, comprising the steps of:

(i) laminating a non-magnetic intermediate layer on the third antiferromagnetic layer after the step (g); and

(j) removing a part of or all of the non-magnetic intermediate layer, followed by laminating the second antiferromagnetic layer in the step (h).

42. The method for manufacturing a magnetic sensing element according to Claim 31, comprising the step of

(k) forming a pair of ferromagnetic layers having a spacing in the track-width direction on the second free magnetic layer and successively forming a pair of the second antiferromagnetic layers having a spacing in the track-width direction on the pair of ferromagnetic layers in place of the step (e).

43. The method for manufacturing a magnetic sensing element according to Claim 42, wherein the total film thickness of the film thickness of the ferromagnetic layer

and the film thickness of the second free magnetic layer is made smaller than the total film thickness of the film thickness of the first free magnetic layer and the film thickness of the second free magnetic layer in the step (k).

44. The method for manufacturing a magnetic sensing element according to Claim 42, wherein a non-magnetic intermediate layer is laminated on the second free magnetic layer, and the ferromagnetic layer is laminated after a part of or all of the non-magnetic intermediate layer is removed in the step (k).

45. The method for manufacturing a magnetic sensing element according to Claim 44, wherein the non-magnetic intermediate layer comprises at least one noble metal of Ru, Re, Pd, Os, Ir, Pt, Au, Rh and Cu in the step (i) or in the step (k).

46. The method for manufacturing a magnetic sensing element according to Claim 44, wherein the non-magnetic intermediate layer comprises Cr in the step (i) or in the step (k).

47. The method for manufacturing a magnetic sensing element according to Claim 42, wherein the spacing in the track-width direction between the pair of second antiferromagnetic layers is made smaller than or equal to the dimension in the track-width direction of the first free

magnetic layer in the step (h) or in the step (k).

48. The method for manufacturing a magnetic sensing element according to Claim 42, wherein the spacing in the track-width direction between the pair of second antiferromagnetic layers is made larger than the dimension in the track-width direction of the first free magnetic layer in the step (h) or in the step (k).